Keiretsu and the automotive added-value chain

Different conventions, namings, systems, formats, policies, constraints, ...
The future of collaborative engineering towards software-defined products

Dr. Alain Pfouga
prostep ivip Association
Grown silos hinder collaboration across the distributed manufacturing value chain.
Standardization Strategy

The business's digitalization goals require solutions and tool chains that are stable and effective.

Engineering IT must enforce standards to reduce data transaction costs and increase efficiency for digital collaboration.

FACTS
- 300+ project partners from Industry and IT
- Creating “Awareness” for engineering IT standards and their crucial role for a seamless digitalization
- Empowering employees especially in a multilateral supply chain
Industrial Digital Transformation
Key drivers of transformation

- CO₂ / Ecological Footprint
- Future markets and customer needs
- Digitalization
- People and Skills
New business paradigms require new development processes

- **VARIABILITY OF THE OBJECTIVES**
  - TIME2MARKET vs. MATURITY vs. QUALITY

- **CO₂ / Ecological Footprint**

- **Future markets and customer needs**

- **Digitalization**

- **People and Skills**

**VALUE CHAIN POSITIONING**
- **BUSINESS FOCUS**
- **DIGITAL CONTINUITY**
- **TRACEABILITY AS FUNDAMENTAL CAPABILITY**
Software in the Product
Hardware as enabling platform for a software added-value chain

**HARDWARE**

Traditional Hardware Cycles

**SYSTEM SOFTWARE (OS)**

Software Intelligence as the Pacesetter

New Development and Synchronization concepts

The focus of standardization is shifting from the ability to industrialize hardware towards robust co-development and interaction between hardware and software of technical systems.

→ We need to intensify efforts and know-how with respect to function based embedded software development for technical systems
SCENARIO
MODEL
SIMULATION
EVALUATION

CHALLENGES

• Rising Complexity of systems such as autonomous driving or ultimate load tests in aerospace

• Uncounted number of possible scenarios (physical prototypes excessive costs and lead time)

• Strong need to work with partners to safeguard everything – and with customers, yet as test drivers for new software in shadow mode, thus reducing the effort for testing

→ How to certify the safety of such systems?

Homologation / Certification
Virtual validation & verification for the homologation of highly complex systems
Virtual testing as a complement of proof and mandatory part of regulations. Standards and legal frameworks for autonomous systems.

Simulation results becoming legally binding.

As an industry consensus:
Necessity to ensure the trustworthiness of virtual validation as test method for homologation in the long term!
People & Skills

Systems and integration mindset as enabler for future challenges

ENGINEERING OF COMPLEX SYSTEMS

MULTIDISCIPLINARY SYSTEM AND SERVICE DESIGN

DIGITAL AND DATA-DRIVEN MINDSET

DATA ENGINEERING

Qualify professionals for tomorrow’s business challenges
Systems Engineering and Data Science disciplines enabling traceability and digital twin
prostep ivip Association
PROSTEP IVIP AT A GLANCE

A strong community since 1993

Leading Worldwide-acting Neutral & Non-Profit Network
180 Members from Manufacturing Industry, IT and Research
Driven & Funded by its Members
Know-how exchange in non-competitive areas
Sharing risks and funds, instead of doing it alone
Best practices, even beyond branches and continents

Digital Transformer in Product Creation & Production
Defining Standards & Interfaces for Digital Processes
Safeguarding industrial Benefits & Interoperability

Expert in IT-Standards & Industrial Implementation
A strong community since 1993
Defining Standards & Industrialization for Digital Transformation:
- e.g. ISO 10303 (STEP), ISO 14306 (JT), LOTAR, OMG ReqIF, Code of PLM Openness - DIN SPEC 91372
- Dozens of prostep ivip, VDA, VDMA Recommendations
- Tons of White Papers and Recommended Practices

Together with Partners to bring the relevant standard(s) to the market:
Technical Work
PROJECT CLUSTERS

1. OPENNESS
   - Standardization Strategy Board (SSB)
   - Code of PLM Openness (CPO)
   - Ontologies

2. INTERNATIONAL STANDARDIZATION
   - ISO 10303 (STEP AP242)
   - ISO 14306 (JT)
   - OMG ReqIF
   - DIN SPEC CPO
   - DIN SPEC JT

3. PRODUCTION COLLABORATION
   - 3D MDM@Cloud
   - Cloud-based Production Collaboration

4. DATA DRIVEN ENGINEERING COLLABORATION
   - Collaborative Digital Twin (CDT)
   - Vehicle Electric (VEC)
   - Requirements Interchange Format (ReqIF)
   - Smart Systems Engineering (SmartSE)
   - Functional Data Exchange (FDX)
   - Jupiter Tessellation
   - Digital Data Package (DDP)
   - ECAD/MCAD
   - MBx-Interoperability
   - Long Term Archiving and Retrieval
   - Project Schedule Management
Improving cross-domain and cross-company collaboration is the mission of the prostep ivip association.

We bundle user requirements, develop standards and make recommendations for collaboration in product development and production.

**FACTS**
- 17 Project groups
- 70 members involved
- International collaboration across 7 countries
Strategic substance
Towards SW-defined products
Extension of the System-V Model – Business Drivers

- Importance of product utilization phase
- Cyber-physical and autonomous systems
- IoT and AI technology
- Iterative and agile development throughout the product life-cycle
- Circular Economy / Engineering
- Holistic view on product development, service and production system development
- Digital and Virtual Twin
- Importance of simulation
- Virtual collaboration between teams
- Software-defined products
- Over-the-air updates / upgrades
Extension of the System-V Model

**Demand**
- Customers, Market
- PESTEL*

**Concept**
- Feasibility Study
- Product Definition

**Development & Validation**
- Product Sign-Off Test

**Production**
- Delivery
- Maintenance, Repair & Overhaul Operations
- Retirement & Replacement

**Operation**
- System Sign-Off Test

**Recycling**

**Product Level**

**System Level**

**Subsystem Level**

**Component Level**

*PESTEL:*
- Political
- Environmental
- Social
- Technical
- Legal…
Extension of the System-V Model

Consideration of the whole lifecycle

Demand → Concept → Development & Validation → Production → Operation → Recycling

- Customers, Market PESTEL*
- Feasibility Study
- Product Definition
- Product Sign-Off Test
- Delivery
- Maintenance, Repair & Overhaul Operations
- Retirement & Replacement

Product Level:
- System Level
- Subsystem Level
- Component Level

Beyond SoP

Sustainability

Multi-discipline, iterative and agile development

Production System Development

Synchronization with Production System and Service Development

Functional decomposition principle remains valid
Extension of the System-V Model: Overlay Concept

- Basic layer as template for specific aspects
- Smart Systems Engineering Use Cases
- Iterative and agile development
- Standards for Smart Systems Engineering
- Modeling, Simulation and Test

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Enabling cross-domain collaboration in MBSE – DDP
Digital Data Package

Viewable
Navigable

Linkable
Traceable

Archiveable

Sources

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Digital Data Package provides a standardized way of integrating data.

### Standardized Package Architecture

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**DDP Recommendation**

- Chapter 4
- MoSSEC
- LOTAR

**Peers**

- Chapter 4.3
- ICF/CEEC
- CDT
- PSI ONT

**Chapter 7**

- ISO
- PSI

**Chapter 8**

- ISO
- CAx IF
Our fields of action

- **Demand**: Customers, Market
  - Feasibility Study
  - PESTEL (Political, Environmental, Social, Technical, Legal...)

- **Concept**: Product Level
  - Mechanics
  - Hardware (E/E)
  - Software

- **Development & Validation**: System Level
  - System Definition
  - Product
  - Sign-Off Test
  - Digital First

- **Production**: System Sign-Off Test
  - Delivery

- **Operation**: Maintenance, Repair & Overhaul Operations

- **Recycling**: Retirement & Replacement

**Component Levels**

- **End2End Data-Driven Traceability**: Software, Hardware (E/E), Mechanics, Production System Development, Service Development

**Digital Leadership**

**Flexible Processes, Methods and Tools**

**Virtual Homologation/Certification**

**Software-Defined Products**
Challenge - „Act Differently”

There are so many new issues that need solutions. Traditional methods or new approaches?

Management of Complexity

Legal Compliance
Sustainability
Change Management
Efficiency
Performance
Software
Functional Safety
Agility
Regulations
Interdisciplinary Collaboration
Thank You!

Networking People

Success for you - and your company